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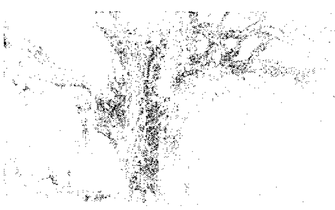

ENVIRONMENTAL IMPACT RESEARCH PROGRAM

TECHNICAL REPORT EL-95-23

VISUAL OBSTRUCTION

Section 6.2.6, U.S. ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

by

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PREFACE

This work was sponsored by the Headquarters, U.S. Army Corps of Engineers (HQUSACE), as part of the Environmental Impact Research Program (EIRP), Work Unit 32420, entitled Development of U.S. Army Corps of Engineers Wildlife Resources Management Manual. Mr. Dave Mathis was the EIRP Coordinator at the Directorate of Research and Development, HQUSACE. The Program Monitors for the study were Dr. John Bushman, Mr. F. B. Juhle, and Mr. Forrester Einarsen, HQUSACE.

This report was prepared by Dr. Wilma A. Mitchell, Stewardship Branch (SB), Environmental Laboratory (EL), U.S. Army Engineer Waterways Experiment Station (WES), and Dr. H. Glenn Hughes, School of Forest Resources, Pennsylvania State University (DuBois campus), DuBois, PA. Dr. Hughes was assigned to EL under an Intergovernmental Personnel Act agreement during the development of this report. Mr. Chester O. Martin, SB, was principal investigator for the work unit. WES review was provided by Mr. Martin, Mr. Michael R. Waring, and Mr. Darrell Evans, SB.

The report was prepared under the general supervision of Mr. Hollis Allen, Acting Chief, SB, EL; Dr. Robert M. Engler, Chief, Natural Resources Division, EL; and Dr. John W. Keeley, Director, EL. Dr. Russell F. Theriot, WES, was the EIRP Program Manager.

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NOTE TO READER

This report is designated as Section 6.2.6 in Chapter 6 -- CENSUS AND SAMPLING TECHNIQUES, Part 6.2 -- VEGETATION SAMPLING TECHNIQUES, of the U.S. ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 6.

VISUAL OBSTRUCTION

Section 6.2.6, U.S. ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

Two major components of vegetative cover are the vertical and horizontal distributions of vegetation. Densities of understory vegetation at different heights above ground (vertical structure) may be important determinants of habitat selection by certain animals. The visual obstruction technique was primarily designed to measure horizontal foliage density, a useful parameter for quantifying the vegetative structure of wildlife cover (Nudds 1977). The technique presented in this report allows the measurement of horizontal cover by estimating the percentage of a profile board that is visually obstructed by vegetation. Details of this technique can be modified in various ways to meet project needs.

TECHNIQUE SELECTION

The major reason for selecting the visual obstruction technique is its application in a wide range of habitat types to evaluate the amount of screening cover available to wildlife species. The technique can be used to determine the horizontal cover in a general vegetative study or to characterize the vegetation of habitats used by selected species. These data permit statistical comparisons of vegetation structure among habitats in one season and among the same habitats at different seasons (Nudds 1977).

Visual obstruction has been used in various designs to ascertain the relationship of cover and habitat use by numerous species. These include the lesser prairie chicken (*Tympanuchus pallidicinctus*)(Guthery et al. 1981), greater prairie chicken (*T. cupido*)(Robel et al. 1970), sharp-tailed grouse (*T. phasianellus*)(Kobriger 1965, Jones 1968), gray partridge (*Perdix perdix*)(Jenkins 1961), other birds (MacArthur and MacArthur 1961, Watson 1964, Recher 1969), rodents (Rosenzweig and Winakur 1969, M'Closkey and Fieldwick 1975), and deer (*Odocoileus* spp.)(Wight 1939, Tanner et al. 1978, Griffith and Youtie 1988).

This technique is a rapid method for measuring the structural profile of vegetation. Equipment is inexpensive, lightweight, easy to construct, and readily maneuverable in the field. The procedure is easy to learn and apply. Two crew members are required to collect data, but the equipment can be modified to accommodate 1 observer.

STUDY DESIGN

The process of site selection and transect establishment is not unique to the visual obstruction technique but may be used in the general study design of most vegetation sampling methods. It is a combination of random and systematic sampling that can be adjusted to fit project needs.

Site Selection

The sites to be sampled should be selected and located on a map of the study area prior to data collection. Sites should be randomly selected if the study area is large and the habitat is fairly homogeneous. However, if the study area consists of diverse habitats, it may be preferable to select sites representative of the vegetation types to be sampled in proportion to the amount of area occupied by each. If screening cover is being estimated for only 1 or a few similar species, transects should be located in typical habitat for those species.

Transects

Sample points are located by following a transect and taking cover readings at intervals (sampling stations) along the transect. Transect lines can be randomly or systematically selected, but should be spaced a standard distance apart. Sampling stations may also be randomly or systematically determined, but systematic location is probably more efficient. To prevent overlap, the spacing of both transects and sampling stations should be at least 20 m (meters) apart.

Sampling Procedure

Sample points. The field crew travels along a transect to the sampling stations and takes cover readings from one or more sample points at each station. The profile (cover) board is placed at the sample point, a distance of 15 m from the point designating the sampling station. This distance was chosen because the greatest variation in foliage density occurs when cover readings are taken at 15 m (Nudds 1977). The board is frequently obscured at greater distances in forest vegetation and is mostly visible at lesser distances so that discrimination among microhabitats is difficult at distances other than 15 m.

The directions travelled from the sampling station to establish the sample points may be random or fixed; however, the latter is probably more efficient than selecting several random directions at each station. Either method is acceptable, but the one chosen should remain constant throughout the study.

Cover estimation. To standardize data collection, the profile board is read with the observer's eye 1 m above ground level. Cover is estimated in percentages. Using actual estimates of percentage screening by foliage provides a more accurate representation of horizontal cover than using cover classes (Guthery et al. 1981). Cover may be estimated for the entire board or for each increment of the board. Incremental estimation will provide data for a structural profile of understory vegetation.

Board modification. The profile board can be adapted to measure foliage structure on any scale for ecology studies of single species or related groups. Investigators may use a board size appropriate for the cover requirements of the target species and determine the standard distance for reading. For small ground-dwelling species, the height of the increments (or strata) may be marked in decimeters rather than meters (Guthery et al. 1981).

Sample Size

Sample size can be calculated if data are separated by points. A formula commonly used to calculate sample size (Snedecor 1950) is

$$N = \frac{s^2 t^2}{d^2}$$

where

N = number of sample points required

s = standard deviation

t = t-value with n-1 degrees of freedom

d = allowable error (i.e., arithmetic mean of the sample total times the designated percent accuracy)

After data collection has begun, these formulas may be used to determine the number of samples needed for adequate sampling. If different vegetation types are inventoried, sample size should be calculated for each representative type.

EQUIPMENT

The only pieces of equipment needed are a 2-m profile board and a 1-m ruler (Fig. 1). The profile board is painted alternating bands of orange and white to facilitate the estimation of vegetation at various heights. The ruler is used to determine the level of the observer's line of vision. It may be eliminated if the field crew has another instrument of 1-m height that can serve a dual purpose, such as one side of a collapsible quadrat. Instructions for the construction of a profile board are given in Appendix A.

PREPARATION

Before initiation of fieldwork, trial runs should be conducted in the type(s) of habitat most likely to be sampled. The field crew should practice using a compass to pace straight transects, and each crew member should determine the number of paces required to lay out the sampling transect.

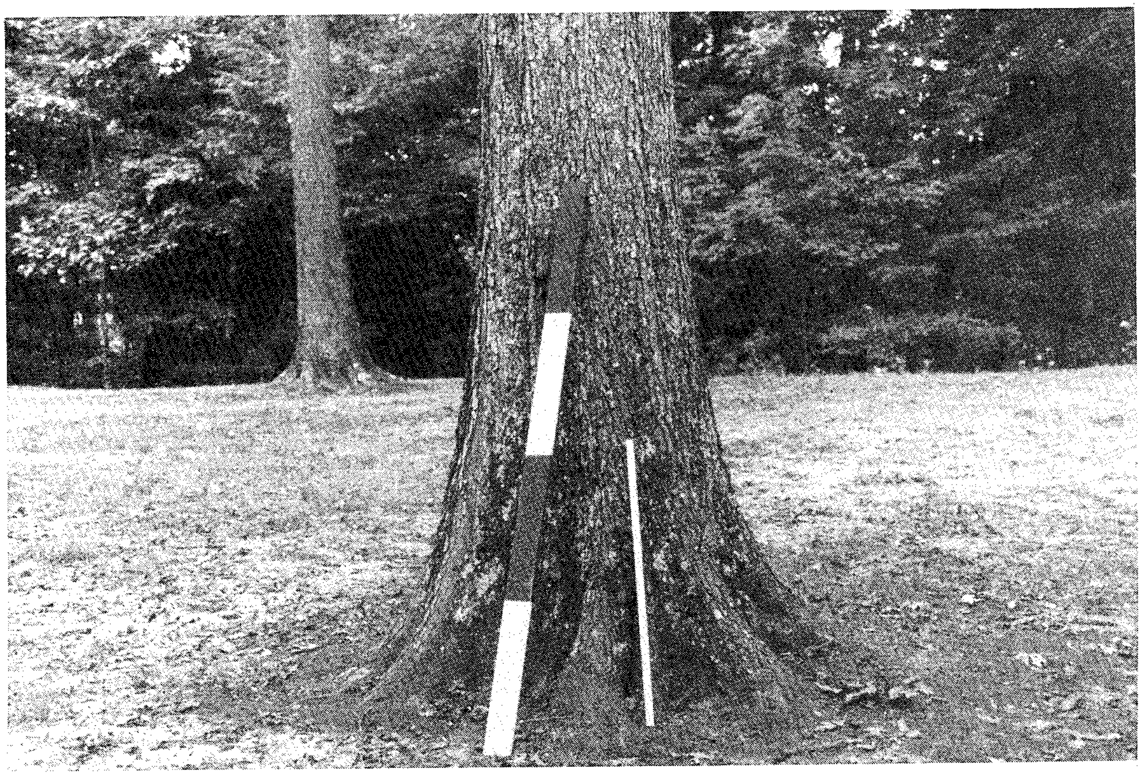


Figure 1. A 2-m profile board and 1-m ruler used in estimating cover for the visual obstruction technique

Field personnel should practice estimating the percentage of vegetation covering the entire board or the individual segments of the board, and compare their estimates at the same sample points. The light intensity and vegetation type will affect the observer's ability to make reliable estimates. Therefore, this technique should be practiced at different times of the day in a variety of habitats to familiarize the observers with changing conditions encountered in the field.

COVER ESTIMATION

An efficient way to estimate the amount of cover obstructing the board is to mentally clump the vegetation and assign a percentage to it. The observer can consider the percentage of the board that would be covered if all the vegetation were moved into 1 aggregate that totally obscured all openings.

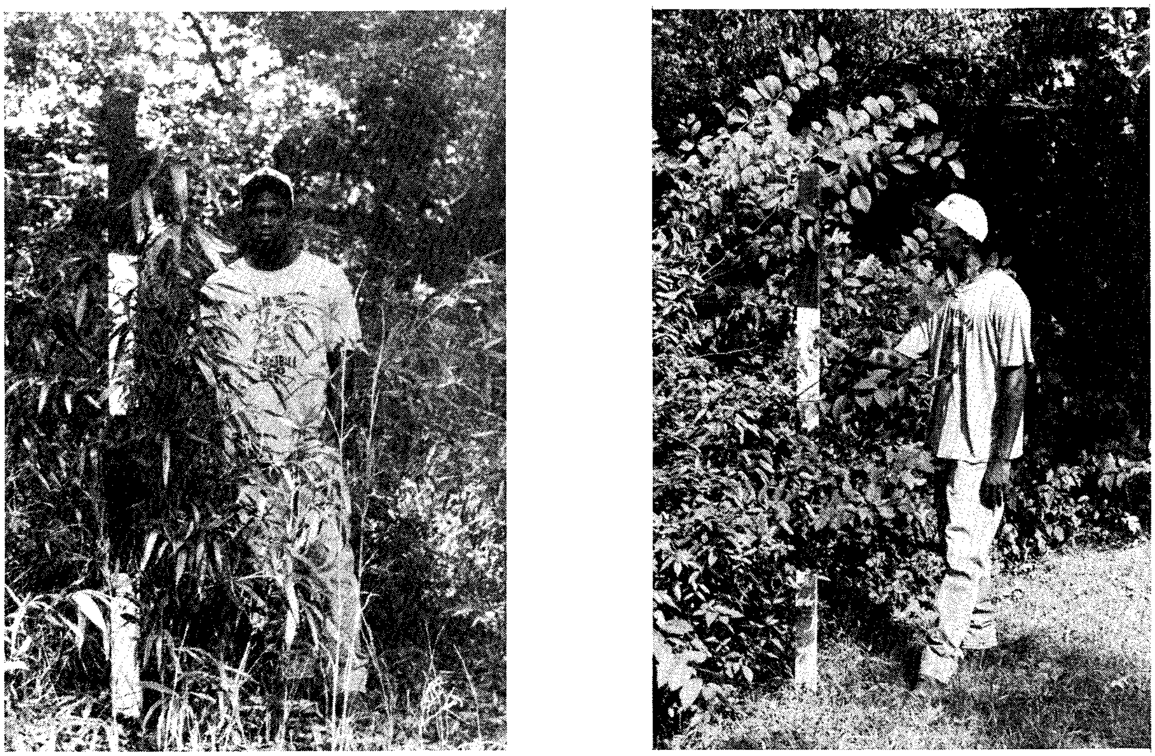
Dense ground cover may obstruct the entire lower section(s) of the profile board (Fig. 2). Since each section (increment) is 25% of the board, total cover of the entire board can be quickly estimated. The 2 lower increments of the board in Figure 2 are completely obscured (50% cover), the top increment is completely visible (0% cover), and the remaining increment is approximately half-covered (12.5% cover). Total cover would be 62.5% for the entire board.

Figure 2. Profile board being used to measure horizontal cover in an old field

Incremental cover is read from the bottom to the top of the board. In Figure 2, total cover would be 100% for increment 1, 100% for increment 2, 50% for increment 3, and 0% for increment 4. Estimating incremental cover provides a more detailed structural profile of vegetation than the single estimate of cover for 2 m of vegetation.

Cover is more difficult to estimate in brush or shrub types of vegetation because of the interstitial spacing among leaves and twigs/branches.

Approximately 30% of the board is visually obstructed in Figure 3a, and about 40% of it is covered in Figure 3b. Excluding shadows on the latter board, percent cover for each increment is approximately 25% for increment 1, 85% for increment 2, 30% for increment 3, and 30% for increment 4 (Fig. 3b). (Percent cover is more difficult to ascertain from photographs than in the field because the observer can discern shadows in live vegetation.)



a b

Figure 3. The profile board being used to measure horizontal cover in a hardwood forest

PROCEDURE FOR DATA COLLECTION

The data collection procedures are detailed below.

1. At each sampling station, the observer remains at a central point to estimate percent cover of the profile board, which will be located at the sample point(s).

2. A second person carries the profile board along a transect to a sample point located 15 m from the observer. Upon reaching the

sample point, the carrier holds the board vertically with a white segment at the bottom (offers more visibility than the colored sections) (Fig. 4).

Figure 4. Field crew collecting visual obstruction data in an old field

3. With the eye level 1 m above the central point, the observer estimates and records the percentage of vegetation covering the profile board (Fig. 4).

4. One reading may be taken to estimate vegetative coverage of the entire board, <u>and/or</u> 4 readings may be taken to estimate coverage of each of the 0.5-m increments. If both readings are performed, total coverage should be estimated at all points first to help eliminate bias. If increment cover is taken, the increment at ground level should be estimated first.

5. If more than one point is sampled at a location, the person with the board returns to the central point and repeats the process described above.

One person can conduct the technique if the board has spikes or nails affixed to one end to hold it upright (Nudds 1977, Griffith and Youtie 1988).

However, additional time will be required for the placement of the board and return to the central point for cover estimation.

An outline of the procedure without figures is provided in Appendix B. This single sheet is convenient to carry into the field as a reminder after the technique has been essentially learned.

RECORDING

Blank data forms are provided in Appendix C. One data sheet is for recording percent cover of the entire profile board, and the other is for recording percent cover of each of the 4 increments on the board. Each data sheet is set up for conducting estimates for 3 sample points at each sampling station; however, the forms could be easily modified to accommodate fewer estimates at a greater number of stations. Station numbers are listed vertically, and the percent cover at each sample point of a station is recorded in the block under the appropriate sample point number.

Sample data sheets with actual visual obstruction data from a mixed shortleaf pine (*Pinus echinata*)-hardwood stand are shown in Figures 5 and 6. The data for percent cover of the entire profile board are shown in Figure 5. At Station 1, total cover is estimated as 50% at sample point 1, 40% at sample point 2, and 50% at sample point 3.

Percent incremental cover from the same location is presented in Figure 6. At the first sample point of Station 1, percent cover is estimated as 75% for the first increment (0-0.5 m), 70% for the second increment (0.6-1.0 m), 30% for the third increment (1.1-1.5 m), and 60% for the fourth increment (1.6-2.0 m).

DATA ANALYSIS

Data analysis consists of determining the average percent horizontal cover within a stand by dividing the sum of the cover readings by the total number of readings. The calculations for determining mean percent cover are given below.

Total Cover

Description. The following calculations are used to find the average percent cover when 1 reading of the 2-m profile board has been taken at 3 sample points per station.

VISUAL OBSTRUCTION
(% Total Cover)

AGENCY/OWNER: USACE PROPERTY: Grenada Lake DATE: 6/2/90

COUNTY: Grenada STAND NUMBER: 28c COMPARTMENT/UNIT: 13 ACREAGE: ______

VEGETATION TYPE: Shortleaf Pine/Hardwoods OBSERVER: Mitchell

SAMPLE POINTS: #1, #2, #3 PAGE 1 of 1

STA. NO.	% COVER (#1)	% COVER (#2)	% COVER (#3)	% COVER at STATION (R)
1	50	40	50	140
2	70	20	40	130
3	90	50	60	200
4	40	45	30	115
5	40	80	40	160
6	40	60	20	120
7	95	40	90	225
8	40	5	50	95
9	40	100	40	180
10	25	50	100	175
11	80	100	75	255
12	100	50	100	250
13	60	40	20	120
14	60	75	70	205
15	30	30	100	160
16	50	20	60	130
17	15	5	25	45
18	100	20	10	130
19	50	40	100	190
20	70	40	75	185
21				
22				
23				
24				
25				

$$\bar{x}\ \%\ \text{Horizontal Cover} = \frac{\Sigma R}{\text{Total No. Readings}}$$

ΣR = 3210 %

$\bar{x}$ % Cover = 54 %

Figure 5. Sample data sheet used to illustrate data recording and analysis of total cover estimations made at 3 sample points per sampling station

VISUAL OBSTRUCTION (% INCREMENTAL COVER)

AGENCY/OWNER: USACE PROPERTY: Grenada Lake OBSERVER: Mitchell DATE: 6/2/90

COUNTY: Grenada COMPARTMENT/UNIT: 13 STAND NUMBER: 28 READINGS/BOARD: 4

VEGETATION TYPE: Shortleaf Pine/Hardwoods SAMPLE POINTS: 1, 2, 3, 4 PAGE 1 of 1

BOARD INCREMENT HEIGHTS: 1= 0 - 0.5 m, 2 = 0.6 - 1.0 m, 3 = 1.1 - 1.5 m, 4 = 1.6 - 2.0 m

STA. NO.	HORIZONTAL COVER				% HORIZONTAL COVER				% HORIZONTAL COVER			
	1	2	3	4	1	2	3	4	1	2	3	4
1	75	70	30	60	40	40	60	25	40	60	40	80
2	20	50	100	90	50	0	50	40	75	50	50	40
3	100	90	75	75	90	50	60	25	85	100	100	30
4	75	50	10	75	50	40	30	80	75	30	10	5
5	50	30	25	20	100	100	60	0	75	0	85	75
6	85	75	30	25	25	100	65	40	50	5	0	10
7	100	95	50	100	75	60	10	20	100	90	75	80
8	20	40	30	40	0	0	5	5	90	50	30	75
9	75	50	40	90	100	100	100	100	40	30	60	55
10	85	20	25	5	100	40	50	50	100	100	100	100
11	60	70	50	70	100	100	100	100	100	100	60	50
12	100	100	100	100	100	85	40	0	100	100	100	100
13	90	90	40	30	40	20	15	45	75	50	40	40
14	75	70	90	75	100	10	40	60	95	100	90	90
15	50	50	10	25	5	15	50	50	100	100	100	100
Σ Cover (m)	1060	950	705	880	975	760	735	40	1200	965	940	930

Total Cover (M)	Σ1= 3235	Σ2= 2675	Σ3= 2380	Σ4= 2450
$\bar{x}$ % Horizontal Cover	< 0.5m = 72%	0.6-1.0m = 59 %	1.1-1.5m = 53%	1.6-2.0m = 57%

$\bar{x}$ % Cover = Σ Cover Readings ÷ Total Number Of Readings

Figure 6. Sample data sheet used to illustrate the recording and analysis of incremental data collected at 3 sample points per sampling station

1. Add the 3 readings (percentages) from each sample point and enter the total in column R (% Cover at Station).

2. Add the percentages in column R and enter the sum at $\sum R$.

3. Find the total number of readings:

   Total readings = Number of readings per station × number of stations

4. The average percent horizontal cover is

$$\bar{x} \text{ \% Cover} = \frac{\text{Sum of readings}}{\text{Total number of readings}}$$

Example. Data from the sample data sheets are used to illustrate the calculations for each step of the procedure outlined above. Use the data in Figure 5 to find the average percent horizontal cover when a reading of the entire profile board has been taken at 3 sample points per station.

1. The sum of the 3 readings at Station 1 is 140%.

2. The percentages in column R have been added to obtain a total of 3210% for all sample points.

3. The total number of readings taken in this stand:

   3 readings per station × 20 stations = 60 readings

4. The average percent horizontal cover for the stand:

$$\bar{x} \text{ \% Cover} = \frac{3210\%}{60}$$

$$= 54\%$$

Incremental Cover

Description. Use the following steps to calculate the average percent horizontal cover for each increment of the 2-m profile board when readings have been taken at 3 sample points per station.

1. Add the 3 cover reading totals ($\sum$ Cover) for each increment and enter the values in the summation blocks in the row entitled "Total Cover."

2. Find the total number of readings for each increment:

   Total readings = Number of readings per station × number of stations

3. Calculate the average percent horizontal cover for <u>each</u> increment of the profile board:

$$\bar{x}\ \%\ \text{Cover} = \frac{\sum \text{Cover readings for increment}}{\text{Total number readings for increment}}$$

<u>Example</u>. Use the data in Figure 6 to find the average percent horizontal cover for each increment of the profile board when estimations have been made at 3 sample points per station.

1. The sum of the readings for increment 1 ($\sum 1$) is 3235% (1060% from sample points 1, 975% from sample points 2, and 1200% from sample points 3).

2. The total number of readings for the first increment:

   3 readings/station × 15 stations = 45 readings

3. The average percent horizontal cover for the first increment:

$$\bar{x}\ \%\ \text{Cover} = \frac{3235\%}{45}$$

$$= 72\%$$

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APPENDIX A

CONSTRUCTION OF EQUIPMENT

MATERIALS

One profile board can be made from a 2-m length of 1- by 4-in. lumber. Other sized boards (e.g., 1- by 5-in. or 1- by 3.5-in.) will be just as efficient. Lightweight material is preferable, but the board should be sturdy enough to prevent warping.

Two cans of different colored spray paints will be required. Fluorescent orange and white colors work well, as they afford better visibility in low light intensity than darker colors such as red. These materials can be purchased from a local hardware store or lumber company for less than $25.00 (1994 prices).

CONSTRUCTION

1. Lightly mark the board at 0.5-m intervals.

2. Carefully cover the first and third increments with heavy paper, and securely tape the edges of the paper to the board (Fig. A1).

Figure A1. Wrapping alternate sections of the board for painting

3. Paint the second and fourth increments with orange spray paint. Prop the board in a secure position and let the paint dry completely.

4. Remove the paper and repeat step 2 for the first and third increments of the board.

5. Paint the first and third increments with white spray paint and let the paint dry.

6. The board is ready to use when the paper has been removed.

<u>Note</u>: The profile board may be easier to transport if it is constructed of two 1-m boards hinged together at the boundaries of 2 alternate color bands.

APPENDIX B

PROCEDURE FOR DATA COLLECTION

PROCEDURE FOR DATA COLLECTION

1. At each sampling station, the observer remains at a central point to estimate percent cover of the profile board, which will be located at the sample point(s).

2. A second person carries the profile board along a transect to a sample point located 15 m from the observer. Upon reaching the sample point, the carrier holds the board vertically with a white segment at the bottom (offers more visibility than the colored sections).

3. With the eye level 1 m above the central point, the observer estimates and records the percentage of vegetation covering the profile board.

4. One reading may be taken to estimate vegetative coverage of the entire board, <u>and/or</u> 4 readings may be taken to estimate coverage of each of the 0.5-m increments. If both readings are performed, total coverage should be estimated at all points first to help eliminate bias. If increment cover is taken, the increment at ground level should be estimated first.

5. If more than one point is sampled at a location, the person with the board returns to the central point and repeats the process described above.

APPENDIX C

VISUAL OBSTRUCTION DATA FORMS

VISUAL OBSTRUCTION
(% Total Cover)

AGENCY/OWNER: ____________________ PROPERTY: ____________________ DATE: ________

COUNTY: ____________ STAND NUMBER: ______ COMPARTMENT/UNIT: ______ ACREAGE: ______

VEGETATION TYPE: ____________________________ OBSERVER: ____________________

SAMPLE POINTS: #1, #2, #3 PAGE _____ of _______

STA. NO.	% COVER (#1)	% COVER (#2)	% COVER (#3)	% COVER at STATION (R)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

$$\bar{x}\ \%\ \text{Horizontal Cover} = \frac{\sum R}{\text{Total No. Readings}}$$

$\sum R$ =	
$\bar{x}$ % Cover =	

VISUAL OBSTRUCTION (% INCREMENTAL COVER)

AGENCY/OWNER: __________ PROPERTY: __________ OBSERVER: __________ DATE: __________

COUNTY: __________ COMPARTMENT/UNIT: ______ STAND NUMBER: ______ READINGS/BOARD: __________

VEGETATION TYPE: ____________________ SAMPLE POINTS: 1, 2, 3, 4 PAGE _____ of _____

BOARD INCREMENT HEIGHTS: 1= 0 - 0.5 m, 2 = 0.6 - 1.0 m, 3 = 1.1 - 1.5 m, 4 = 1.6 - 2.0 m

STA. NO.	HORIZONTAL COVER				% HORIZONTAL COVER				% HORIZONTAL COVER			
	1	2	3	4	1	2	3	4	1	2	3	4
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
$\sum$ Cover (m)												

Total Cover (M)	$\sum 1=$	$\sum 2=$	$\sum 3=$	$\sum 4=$
$\bar{x}$ % Horizontal Cover	< 0.5m =	0.6-1.0m =	1.1-1.5m =	1.6-2.0m =

$\bar{x}$ % Cover = $\sum$ Cover Readings ÷ Total Number Of Readings

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13. ABSTRACT *(Maximum 200 words)*

A report on visual obstruction as a vegetation sampling technique is provided as Section 6.2.6 of the U.S. Army Corps of Engineers Wildlife Resources Management Manual. This technique can be used by the Corps District or project biologist to estimate percentage horizontal cover of understory communities. Topics covered include guidelines for technique selection and study design, preparation for sampling, and procedures for data collection, recording, and analysis.

The visual obstruction technique is a rapid method for measuring the structural profile of understory vegetation. Designed to measure horizontal foliage density, this technique is useful for estimating the amount of screening cover available to ground-dwelling wildlife species. It allows the measurement of horizontal cover by estimating the percentage of a 2-m profile board that is visually obstructed by vegetation. Equipment is inexpensive, data collection

(Continued)

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17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
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13. (Concluded).

can be conducted by either 1 or 2 field personnel, and the method is applicable in a wide range of habitat types.

Detailed instructions are given for recording and analyzing data; these are accompanied by numerical examples that illustrate each step of recording and data analysis. A reproducible form is also provided for recording and calculating visual obstruction data.

14. (Concluded).

Cover board
Cover estimation
Profile board
Horizontal cover
Incremental cover
Rapid sampling technique
Screening cover
Vegetation profile
Vegetation sampling
Visual obstruction